

What is claimed is:

1. A system for performing sputter etching, comprising:
 - (a) an ion source that generates an ion current directed at a substrate;
 - (b) an electron source that generates an electron current directed at the substrate;
 - 5 (c) biasing circuitry that biases the substrate with an a-symmetric bi-polar DC voltage pulse signal, the circuitry being formed from a positive voltage source with respect to ground, a negative voltage source with respect to ground and a high frequency switch;
 - (d) at least one current sensor, coupled to the biasing circuitry, that monitors a positive current and a negative current from the substrate during one or more cycles of the a-
 - 10 symmetric bi-polar DC voltage pulse signal;
 - (e) a controller, coupled to the at least one current sensor, that varies the ion current independently from the electron current;
 - (f) wherein the ion and electron sources create a continuous plasma proximate the substrate, and the biasing circuitry causes the substrate to alternatively attract ions and electrons
 - 15 from the plasma;
 - (g) wherein the ions attracted from the plasma sputter etch the substrate; and
 - (h) wherein the electrons attracted from the plasma neutralize accumulated charge on the substrate.
- 20 2. The system of claim 1, wherein the ion source, the electron source and the substrate are disposed in a chamber having a pressure between 10^{-3} to 10^{-5} torr during operation of the system.
3. The system of claim 1, wherein the controller varies the a-symmetric bi-polar DC voltage pulse signal used to bias the substrate independently from the ion and electron currents.

4. A method for performing sputter etching, comprising:

- (a) generating an ion current directed at a substrate by an ion source;
- (b) generating an electron current directed at the substrate by an electron source;
- (c) biasing the substrate with biasing circuitry that generates an a-symmetric bi-polar

5 DC voltage pulse signal, the circuitry being formed from a low voltage source, a high voltage source and a high frequency switch;

(d) monitoring, with at least one current sensor coupled to the biasing circuitry, a positive current and a negative current from the substrate during one or more cycles of the a-symmetric bi-polar DC voltage pulse signal;

10 (e) varying, with a controller coupled to the at least one current sensor, the ion current independently from the electron current;

(f) wherein the ion and electron sources create a continuous plasma proximate the substrate, and the biasing circuitry causes the substrate to alternatively attract ions and electrons from the plasma;

15 (g) wherein the ions attracted from the plasma sputter etch the substrate; and

(h) wherein the electrons attracted from the plasma neutralize accumulated charge on the substrate.

5. The method of claim 4, further comprising:

20 adjusting an ion kinetic energy E of the ion current produced by the ion source to between 20 eV and 200 eV;

tilting a surface plane of the substrate such that energetic ions produced by the ion source approach the surface plane of the substrate at an angle θ between normal incidence and grazing incidence;

adjusting an amplitude of negative voltage pulses applied to the substrate to a desired
5 value of V_{neg} ;

wherein ions striking the substrate have an angle of incidence α which is represented by a vector sum of a velocity imparted by acceleration of the ion source and a velocity imparted by the negative voltage pulse amplitude applied to the substrate; and

wherein ions striking the substrate remove material from the substrate due to sputtering at
10 the angle α .